several reflections had to be considered. It has been completed for three reflections, and Mr. Max Mason, of Madison, to whom I am greatly indebted for his patient work in assisting me, is going on with the series. As will be seen, the wave has already become quite complicated, and it will be interesting to see what further changes result after three or four more reflections. I am also under obligations to Prof. A. B. Porter, of Chicago, who prepared the set of drawings illustrating the passage of a wave out from the principal focus of a hemispherical mirror.

R. W. WOOD.

NOTES.

MANY friends and admirers of the late Sir William Flower will be glad to know that a committee has been formed, with Lord Avebury as chairman, to secure the erection of a memorial to him. It is proposed that the memorial shall consist of a bust and a commemorative brass tablet to be placed in the Whale Room of the Natural History Museum—one of the departments in which he was most interested, and to which he devoted special care and attention. There should be a ready response to the invitation for subscriptions to carry out this scheme, for Sir William Flower's services to science are appreciated by every one interested in the extension of natural knowledge. The Natural History Museum ought not, indeed, to be without a memorial of the man who took such an active part in its development. Subscriptions (which must not exceed two guineas) should be paid to Dr. P. L. Sclater, treasurer of the Flower Memorial Fund, 3, Hanover Square, W.

IN the House of Commons on Tuesday, Mr. Goschen gave some particulars with regard to the Committee to inquire into the boilers of her Majesty's ships. The Committee will consist of seven members, and the president will be Vice-Admiral Sir Compton Domvile. The other members of the Committee already chosen are Mr. List, superintending engineer of the Castle Company; Mr. Bain, superintending engineer of the Cunard Line; Mr. Milton, chief engineer surveyor of Lloyd's Registry of Shipping; Prof. Kennedy, formerly professor of engineering at University College; and, sixthly, an engineer of the Royal Navy holding the rank of an inspector of machinery. The seventh member of the Committee has not yet been selected. The instructions to the Committee are:—To ascertain practically and experimentally the relative advantages and disadvantages of the Belleville boiler for naval purposes as compared with the cylindrical boiler. To investigate the causes of the defects which have occurred in these boilers and in the machinery of ships fitted with them, and to report how far they are preventable either by modifications of details or by difference of treatment, or how far they are inherent in the system. Also to report generally on the suitability of the propelling and auxiliary machinery fitted in recent war vessels, and to offer any suggestions for improvement, stating at the same time the effect as regards weight and space of any alterations proposed. To report on the advantages and disadvantages of the Niclausse and Babcock and Wilcox boilers compared with the Belleville, as far as the means at the disposal of the Committee permit, and also to report whether any other description of boiler has sufficient advantages over the Belleville or the other two types mentioned, as a boiler for large cruisers and battleships, to make it advisable to fit it in any of her Majesty's ships for trial. For the purpose of making direct experiments between ships fitted with Belleville and cylindrical boilers respectively, the *Hyacinth*, fitted with Belleville boilers, will be placed at the disposal of the Committee. A cruiser of similar type fitted with cylindrical boilers will also be placed at the disposal of the Committee when required for the purpose of comparison. Mr. Goschen added that it is particularly desired that any conclusions the Committee may arrive at should be supported by experimental proof as far as possible, and that they should propose any further experiments which may be considered necessary for this purpose.

WE learn from the *Electrician* that a prize of 1000 francs (40*l.*) is being offered by the Association des Industriels de France contre les Accidents du Travail, 3, Rue de Lutece, Paris, for the most efficacious insulating gloves for electrical workmen. They should be strong enough to resist not only the electric pressure, but also accidental perforations by copper wires, &c., and must, in addition, be easy to wear by hands of any size and allow the workmen's fingers sufficient freedom to execute their work. The competition is international, and competitors must send two pairs of gloves, accompanied by an explanatory note, to the president of the Association before December 31, 1900. The Association reserves to itself the right to publish descriptions of samples submitted to it, and inventors should therefore take the precaution of protecting their inventions previously.

A GLANCE through the addresses delivered at the meeting of the British Medical Association held at Ipswich last week, and published in the *British Medical Journal*, shows that leading members of the medical profession recognise the close relationship between medicine and other sciences. The president, Dr. W. A. Elliston, in an address in which he traced the developments of the science of British medicine and the evolution of the modern physician, remarked: "I am not unmindful of the up-to-date requirements of general culture—of an accurate knowledge of anatomy, chemistry, physiology, biology, bacteriology, pathology, physics, optics, mechanics, electricity and photography, which are all essential to the well-educated physician; they are daily called into requisition in order to diagnose and to direct the eye and hand in the treatment of disease." Similar acknowledgment of the dependence of medicine upon other sciences was made by Dr. Pye-Smith in his address abridged in another part of the present number. Mr. Frederick Treves, however, in his address on the progress of surgery during the last hundred years, ended his remarks with a sketch of the surgeon's place in the future, and expressed the hope that surgery might remain a handicraft, and that before all things the surgeon would strive to render his own hands self-sufficing, and not trust too much to diagnoses made for him in the laboratory. Short addresses were delivered by some of the presidents of the thirteen sections of the Association. In the section of pathology, Dr. E. E. Klein spoke upon bacteriology in relation to pathology, giving as illustrations of his theme the bacteriological work bearing upon inflammation, necrosis and cell secretions. Dr. Howard Marsh, in his address to the section of surgery, remarked: "Long a mere matter of routine, the treatment of fractures has lately felt the influence of modern advance in other departments of surgery. The Röntgen process secures an accuracy of diagnosis which formerly was often impossible." Dr. W. G. Smith made some suggestive remarks upon the teaching of pharmacology, pointing out some of the relationships between physiological action and chemical constitution. This fascinating subject has occupied the attention of several physiological chemists, and it offers numerous interesting problems for investigation.

WE learn from the *Athenaeum* that the 83rd Annual Meeting of the Swiss Natural Science Society will be held at Thüsis, Canton Grisons, from September 2–4. Three other Swiss scientific societies—the geological, the zoological, and the botanical—will hold their annual meetings at the same time and place. Intending guests are asked to communicate with the president, Dr. Lorenz, at Coire, as soon as possible. Prof. Forel, of Morges, will lecture at the general meeting of the

Society on changes in glaciers; Prof. Zschokke, of Basle, on the fauna of mountain streams; and Prof. Schardt on the tectonic conditions on the northern slopes of the Swiss Alps.

A LENGTHY treatise on that mysterious form of atmospheric discharge known as "globe lightning" appears in the current number of the *Annalen der Physik*. It is by Prof. Max Toepler, the inventor of the Toepler machine and the discoverer of the stratified brush discharge. After comparing all the published records of the phenomenon, he comes to the conclusion that the globe is a form of continuous atmospheric discharge analogous to the "brush arc discharge" of the laboratory. A lightning flash leaves behind it a track of heated and possibly ionised air, along which a slow continuous discharge passes for some time after the flash has passed. When this continuous discharge is strong enough, any part of the track which has an exceptionally high resistance may be made to glow, and the glow may continue for several seconds or even half a minute. The track may be blown aside by the wind or driven by electrostatic forces, and then the globe will be seen to wander as is usually described. It often finishes with another lightning flash, and the thunderclap following that is described as an "explosion" of the ball. Considering the size and duration of the globe, Prof. Toepler estimates its current strength at something between 2 and 20 amperes. Considering that a lightning flash often carries 10,000 amperes, the destruction wrought by globular lightning should be inconsiderable.

THE uses of monochromatic light in optical experiments are so numerous that considerable interest attaches to the paper, on the means of producing such light, by MM. Charles Fabry and A. Pérot in the *Journal de Physique* for July. After pointing out the disadvantages of sodium light on account of the proximity of the D lines, the authors divide the methods of producing a beam of monochromatic light into two, viz.: (1) simplification of a beam of white light, and (2) use of light emitted by a gas. Under the latter method are included (*a*) flames; (*b*) gases or vapours rendered luminous by electricity; (*c*) induction sparks; and (*d*) the electric arc. In connection with (*b*), it is found that the quality of the rays depends on the nature of the current exciting them, and the authors consider the use of (1) a coil with secondary condenser, (2) alternating currents, (3) continuous currents; of these methods the last is the best, though the second is better than the first. While the results of these investigations cannot be briefly summarised, we notice that the authors have shown the possibility of improving the action of Michelson's tubes, of using a modification of the mercury arc of Arons as a source of monochromatic light of great intensity, of using the rays of a certain number of metals for interference observations where the difference of path is considerable, and, by measuring the wave-lengths, of adding a number of new fixed points on the spectrum. The paper concludes with a table of wave-lengths determined by MM. Pérot and Fabry, and compared with the determinations of Michelson.

STORMY and boisterous weather has occurred over the greater part of the British Islands during the past week, and exceptionally heavy rains have been experienced in many districts. On August 3 a storm of unusual severity for the time of year swept across England, and a heavy gale blew over the southern portion of the kingdom, occasioning considerable damage on our coasts, as well as to the fruit and corn in the inland districts. A similar disturbance struck our west coasts on August 6, and although it followed very much the same path as the storm of Friday it was more erratic, both in its track and rate. The storm was heavy again in many parts of England, and further damage to the crops has been occasioned. The temperature has fallen considerably during the last few days, and the weather has been cold for the time of year over the whole country, the mid-day readings in many places being below sixty degrees.

THE new Daily Weather Report, the issue of which was announced in NATURE of July 26 (p. 300), is now on sale every day at the Meteorological Office and several railway bookstalls in London. The attempt thus made to create an intelligent interest in meteorological records and forecasts is one to be encouraged, but we are afraid that the method adopted is not very attractive. The weather charts are admirable, and in connection with the statement of the general situation and the forecasts they are most instructive. Too much prominence could not be given to these two pages of the Report, which ought to find a place in the hall of every educational institution in the country. But the tabular matter included in the Report is of too detailed a character to be of public interest, and the Meteorological Council might usefully consider whether it would not be sufficient to publish such statistical information once a week or once a month instead of every day.

THE high kite flight at Blue Hill Meteorological Observatory, of which mention was made a few weeks ago (p. 252), was, Mr. Lawrence Rotch informs us, exceeded on July 19. A line of six kites reached an altitude of 15,900 feet, or three miles and sixty feet, above the sea, which exceeds the highest point ever reached in America by a balloon used for scientific purposes. Prof. Hazen, of the U.S. Weather Bureau, obtained observations in a balloon at a height of 15,400 feet in an ascent from St. Louis in June 1887. This is the highest ascent in America from which observations have been published. Four and three-quarter miles of steel piano-wire were used at Blue Hill as a flying line. The instruments attached to the kites showed freezing temperature at the highest point and a north-west wind with a velocity of twenty-six miles an hour. The air was found to be exceedingly dry.

THE *Proceedings* of the Geologists' Association for May contains an interesting paper, entitled "The Natural History of Phosphatic Deposits," being an address delivered in February last by the retiring President of the Association, Mr. J. J. H. Teall, F.R.S. The phosphates of igneous rocks and mineral veins are first discussed, and it is pointed out that apatite, the most abundant phosphatic mineral, is the principal source from which the phosphorus of the sedimentary rocks and of organic bodies is derived. Attention is drawn to the points of analogy in the vein-occurrence of apatite and tin-stone. Having shortly described the conditions and causes which bring about the formation of modern phosphatic deposits, the author passes in review the principal occurrences of phosphates in the successive geological formations, and concludes by stating that "from the earliest time down to the present day, the physical and chemical conditions under which phosphatic deposits have been formed have remained essentially the same." A useful bibliography of the subject is appended.

IN the *Bulletin de la Classe des Sciences* of the Brussels Academy (1900, No. 4), M. Louis Dollo, curator of the Brussels Museum, describes the new fish, *Racovitzi glacialis*, discovered in the Belgian Antarctic Expedition. This is the third new fish discovered by the party, and only one specimen was found, and that a small one, somewhat mutilated at the caudal extremity, the length of the body, exclusive of the tail, being 82 millimetres. It was found on May 28, 1898, in lat. 71° 23′ S., long. 87° 32′ W., depth 435 metres, and is a member of the family Trachinidæ, distinguished from the genera Bathydraco, Bembrops, Chænichthys, Cryodraco and Gerlachea by well-marked characteristics, which M. Dollo describes. It is, however, most nearly allied to Bathydraco and Gerlachea, and its existence within the Antarctic Circle furnishes a fresh proof of the frequency of the Trachinidæ in the neighbourhood of this circle.

A SUGGESTIVE paper on the driving energy of physico-chemical reaction and its temperature-coefficient is contributed to the *Proceedings* of the American Academy of Arts and Sciences, xxxv. 23, by Prof. Theodore William Richards, in which the author, starting with the close similarity between the equations of Clausius and van 't Hoff, $d\ln P/dT=\lambda/RT^2$ and $d\ln K/dT=U/RT^2$, points out the advantages, previously recognised by Arrhenius, of regarding *pressure* to be the fundamental quantity which determines the progress of chemical reactions, as this aspect affords a more direct method of analysis than the study of volume, concentration or entropy. An expression called the "reaction metatherm" is evolved, which represents in terms of pressure the temperature-coefficient of the equilibrium ratio of ideal physico-chemical reaction. The equation obtained is the mathematical expression of the theorem of Maupertuis or Le Chatelier, and when analysed it shows that the part played by each substance in a reaction may be considered as the logarithm of the product of its "physico-chemical potential" and its actually present pressure. The reaction metatherm may be simplified into a reaction-isobar and a reaction-isochor, according as the pressure or volume is kept constant during the reaction. While, however, the reaction-isobar offers the most convenient basis for calculations to which it is applicable, results under constant volume are more conveniently calculated if the reacting substances are expressed in terms of concentration according to the equation of van 't Hoff.

THE iconography and anthropology of the Irano-Indians is the subject of a recent study by M. Ujfalvy in the current volume of *l'Anthropologie*. He concludes that the ancient Persians had a narrow-faced, dolichocephalic, somewhat flattened head resembling that of the ancient Hindus. They were all fair or reddish, and closely resembled the Macedonians of Alexander. It is impossible to say whether this was the primitive Persian type; at all events, it was their well-characterised type six centuries before our era. Two centuries later the type began to be slightly modified. This took place in the interval between the decline of the dynasty of the Achemenides (328 B.C.) and the rise of that of the Sassanides (240 A.D.). This alteration was probably due to the Semites of Elam and Syria, and to the Turanians of Babylon. The former influence did not affect the dolichocephaly, but it slightly increased the height of the head, and modified the nose considerably. The latter influence shortened the head, and but slightly modified the face. The Sassanide warriors exhibited the new complex type. At the close of the Sassanide period the Arabs reinforced the Semitic characters. M. Ujfalvy accepts and reinforces Houssay's dictum that, in a mixture of Aryans with Mongols or Mongoloids, the latter lose their facial characters, flattening of the nose, prominence of the cheek-bones, absence or sparseness of the beard; but, in exchange, they impose the shape of their skull on the former.

MESSRS. SWIFT AND SON have just patented a very handy little electric lamp for microscopic purposes. The lamp—a 16 candle-power one—is enclosed in a metal cylinder, the inner surface of which is painted white. The light makes its exit through a circular aperture in the side of the cylinder near its free end; the end is closed by a plate set at an angle of 45° and painted white, so as to reflect the light through the circular aperture. The light thus does not pass direct from the incandescent carbon filament to the mirror of the microscope, but is reflected from the white walls of the cylinder. In this way a very even illumination is obtained, which is more uniform than that obtained from the average ground glass lamp. While, however, the light given by this lamp is admirably suited for the ordinary powers such as are attached to the average student's microscope, it is, in our opinion, neither powerful enough nor white enough for high-power work, this being a defect common to all electric microscope lamps. Where in addition a lamp is required for dissection purposes, as is so often the case, the direct light of the ordinary type of electric lamp will be found more suitable. This lamp is very compact and steady, and its movements, especially those about its horizontal axis, are particularly easy and steady.

THE Botanical Museum of Florence has recently received a donation of considerable interest in connection with the history of botany in Italy, viz. the collections made by Micheli, by Bruno Tozzi, and by G. Targioni-Tozzetti in the 18th century, including the type-specimens of species named by these and other eminent botanists. The donation includes also Micheli's and Targioni-Tozzetti's collections of sea-weeds.

IN No. 4 of vol. xxi. of *Notes from the Leyden Museum*, Dr. J. Büttikofer, the director of the Zoological Garden at Rotterdam, records the birds collected by the Dutch expedition to Central Borneo. Testimony is borne to the thoroughness of the work of the English naturalists, the late Messrs. Everett and Whitehead, and Mr. Charles Hose, by the fact that the author has not been able to add a single new species to the avian mountain fauna of the island. Dr. Büttikofer comes to the conclusion that both the mammalian and the avian faunas of Borneo are remarkably homogeneous, especially so far as the lowlands and the mountain bases up to an elevation of about 1000 metres are concerned. In vol. ii. No. 1 of the same serial, Mr. M. C. Piepers defends his theory of the evolution of colour in Lepidoptera, as explained at the recent Zoological Congress at Cambridge, against the criticisms of Miss Newbiggin and Dr. von Linden.

IN *Nature Notes* for August the Selborne Society refers to the urgent need of a crusade against pigeon-shooting.

THE MS. of the second volume of the late Dr. Stark's "Birds of South Africa" has been found amongst the papers of the deceased naturalist, who was killed at Ladysmith during the siege. It has been revised for the press by Mr. W. L. Sclater, director of the South African Museum, Cape Town, and will be shortly published by Mr. R. H. Porter. It will form part of Mr. Sclater's series of volumes on the fauna of South Africa.

THE report of the Zoological Garden of Calcutta for the year 1898–99, which has recently been received in this country, gives a favourable impression of the present condition and prospects of this establishment, drawn up by Lieut.-Colonel P. A. Buckland, the honorary secretary and treasurer. The superintendent of the Calcutta Garden, Babu R. B. Sanyal, who represented that Institution at the International Congress of Zoology at Cambridge in August 1898, contributes to this report an interesting account of his experiences at the Cambridge meeting, and of his observations on many of the zoological gardens of Europe, which he took the opportunity of visiting on the same occasion.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. T. Forsyth Forrest; a Diana Monkey (*Cercopithecus diana*) from West Africa, presented by Mr. W. Cleaver; two Greater Vasa Parrots (*Coracopsis vasa*) from Madagascar, presented by Mr. G. Barfoot; a Silky Cowbird (*Molothrus bonariensis*) from South America, presented by Mr. F. Willes; seven Algerian Skinks (*Eumeces algeriensis*), a Spiny-tailed Mastigure (*Uromastix acanthinurus*) from North Africa, presented by Mr. G. H. Fernan; a Common Viper (*Viper berus*), British, presented by Mr. Alfred Cooper; a Green Lizard (*Lacerta viridis*), a Dohl's Snake (*Zamenis dahli*), European; two Snakes (*Coluber prasinus*) from Upper Burmah, deposited; two Ring-necked Pheasants (*Phasianus torquatus*),

two Gold Pheasants (*Thaumalea picta*) from China, a Pheasant (*Phasianus colchicus*), five Barn Owls (*Strix flammea*), British, purchased; a Japanese Deer (*Cervus sika*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET BORRELLY-BROOKS (1900 *b*).—Several observations of this comet are announced. The comet is at present easily seen with a small telescope, but is becoming fainter.

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A. h. m. s.	Decl. ° ′	Br.
Aug. 9 ...	3 11 45 ...	+61 11·9 ...	0·91
10 ...	15 14 ...	63 37·6 ...	87
11 ..	19 12 ...	65 56·8 ...	83
12 ...	23 41 ...	68 9·4 ...	79
13 ...	28 47 ...	70 15·6 ...	75
14 ...	34 46 ...	72 15·3 ...	71
15 ...	41 48 ...	74 8·6 ...	67
16 ...	3 50 8 ...	+75 55·7 ...	0·63

During the week the comet passes rapidly northwards from α Persei, across into Camelopardus, and then near the boundary of this constellation and Cassiopeia. Its path is at present so nearly linear that it may be found by sweeping along the direction formed by the stars π, κ and α Persei.

EPHEMERIS OF COMET 1894 IV. (SWIFT).—Mr. F. H. Seares sends the following search ephemeris for the assistance of interested observers:—

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A. h. m. s.	Decl. ° ′
Aug. 8 ...	15 57 20 ...	−24 32·8
12 ...	15 59 31 ...	36·0
16 ...	16 2 10 ...	40·2
20 ...	16 5 17 ...	45·4
24 ...	16 8 50 ...	51·4
28 ...	16 12 50 ...	−24 58·1

VARIABLE STARS IN CLUSTERS.—*Harvard College Observatory Circular* (No. 52) contains the results of the measures of a set of photographs of the star cluster Messier 3 (N.G.C., 5272). This object is so low in the sky at Arequipa, and the stars so faint, that satisfactory photographs of it could not be obtained with the 13-inch Boyden refractor with exposures less than 90m. The rate of increase of the light of many of these stars is extremely rapid, and in order to determine such change with the greatest precision, it is necessary to have photographs taken with short exposures. Accordingly, at Prof. E. C. Pickering's request, Prof. J. E. Keeler has taken a series of excellent pictures of the cluster with the 3-foot Crossley reflector of the Lick Observatory The first of these had an exposure of 60m., while twenty-four others were obtained with exposures of 10m. each. Prof. Bailey has examined these photographs very carefully, devoting attention specially to three of the variable stars. It has previously been stated (*Circular* No. 33) that the proportion of variable stars is greater in this cluster than in any other object of the same class.

The periods of the three variables were found to be: No. 11, 12h. 12m. 25s.; No. 96, 12h. 0m. 15s.; No. 119, 12h. 24m. 31s. The variations were recorded for intervals of 5m., and are given in a table. From this it appears that the total increase of light takes place in the case of No. 11, within 70m.; No. 96, within 60m.; and No. 119, within 80m. The greatest rapidity of increase of light occurs in the star No. 96, which increases during 5m. at the rate of at least 2·5 magnitudes per hour, and during 30m. at the rate of more than 2·0 magnitudes per hour. This rate of change appears to be the most rapid of any known variable. The Algol variable U Cephei, which perhaps undergoes the most rapid change of any variable *not* found in clusters, changes at the rate of about 1·5 magnitudes per hour during about 30m. of its period. In all these stars the rate of change is relatively slow near the beginning and end of the period of increase. In No. 96 the increase is about *ten* times as rapid as the decrease. Generally speaking, the lengths of period and form of light curves of these three stars are similar to those of the variables in the clusters Messier 5 and ω Centauri (*Astrophysical Journal*, vol. x. p. 255).

RECENT INVESTIGATIONS ON RUST OF WHEAT.

RUST, or mildew, is familiar to the agriculturist as a disease destructive to wheat and other cereals, and to the botanist as the subject of important researches relating to fungi. It was known in times of antiquity, as shown by numerous references indicating its destructiveness. Virgil says, "Soon, too, the corn gat sorrow's increase, that an evil blight ate up the stalks" ("Georgics," i. 150–1). In Britain, it is stated that "mildew of wheat-plants has been known for over 300 years, according to the records" ("Report on Mildew on Wheat Plants, 1892," Board of Agriculture, 1893, p. 25). Shakespeare ascribes it to "the foul fiend Flibbergibbet" (*King Lear*, Act iii. Scene 4). The works on husbandry of Hartlib (1655) and Jethro Tull (1731) refer to it. The connection of rust of cereals with a specific fungus is generally ascribed to Fontana (1767), and Persoon, after further investigation, in 1797 named the fungus *Puccinia graminis*. An account of rust, with illustrations of the *Puccinia*, by Sir J. Banks in 1805, is apparently the first important paper on the rust and its fungus in Britain. Since then the epidemic has been the subject of many papers, and of, at least, three organised inquiries. The historical side of the subject is conveniently summarised by Worthington G. Smith ("Diseases of Crops," London, 1884, Chapter xxv.), by C. B. Plowright ("British Uredineæ and Ustilagineæ," London, 1889, p. 46), and in the Board of Agriculture report ("Report on Mildew on Wheat Plants, 1892," Board of Agriculture, 1893, p. 25).

Rust of wheat occurs throughout Britain, especially in the wheat-growing districts, and forms of it are found on oat, barley, rye, and almost all grasses The losses from the form on wheat, reported to the Board of Agriculture in 1892, vary from nine to sixteen bushels per acre of crop. Rust-epidemics have been the subject of special attention in Europe, more particularly in Sweden, Germany, France and Austria. A rust conference was formed in 1890 for Australasia, and still continues to meet. In the United States of America, the Department of Agriculture sanctions the statement that "the damage to wheat and oats from rust in this country probably exceeds that caused by any other fungous or insect pest, and in some localities is greater than that caused by all other enemies combined" (Carleton, M. A., "Cereal Rusts of the United States," U.S. Department of Agriculture, *Bulletin* 16, 1899). In India and Japan, substantial losses are ascribed to this disease.

The remedy for this epidemic is a difficult problem, and the aim of recent research has been, in the first place, to obtain a true conception of the fungus causing it. The facts leading up to recent investigations may be briefly reviewed. It is an old and deep-rooted belief amongst growers of wheat that the rust of their crops is influenced by the neighbourhood of barberry bushes. Evidence of this is seen in certain old enactments enforcing destruction of the barberry; for instance, that passed by a parliament at Rouen in 1660, and others included in the Province Law of Massachusetts (America) between 1738 and 1761. Sir Joseph Banks, in his paper (1805), holds the same opinion.

In 1841 Prof. J. S. Henslow (*Journal* of the Royal Agricultural Society, vol. ii. 1841) suggested that the yellow summer rust of wheat, and the black mildew which comes later, are stages in the life of one and the same fungus. Passing over many papers discussing these relationships, we come to one by De Bary published in 1865 ("Untersuchungen üb. Uredineæ." *Monatsber. d. Berlin Akad.*, 1865). From his experiments De Bary concludes, that the yellow summer rust (*Uredo linearis*, Persoon) on *Gramineae*, the black autumn rust (*Puccinia graminis*, Persoon) also on *Gramineae*, and the rust on barberry (*Aecidium berberidis*, Persoon) with its associated "spermogonia" stage, are phases in the life-history of the same fungus, for which the name *Puccinia graminis* is retained. In other words, that three (or four) recognised species of fungi are one and the same. At the same time a new phenomenon in the life of fungi was revealed, namely, that there existed parasitic fungi which required two host-plants in order to develop the forms of reproduction included in their life-cycle; this De Bary named metœcism or (as better known in Britain) heterœcism. The life-history of *Puccinia graminis*, as defined by De Bary, is given in all our text-books. Uredospores (see Fig. 1) are produced on wheat and other *Gramineae* throughout the summer, and infect the same group of host-plants; the